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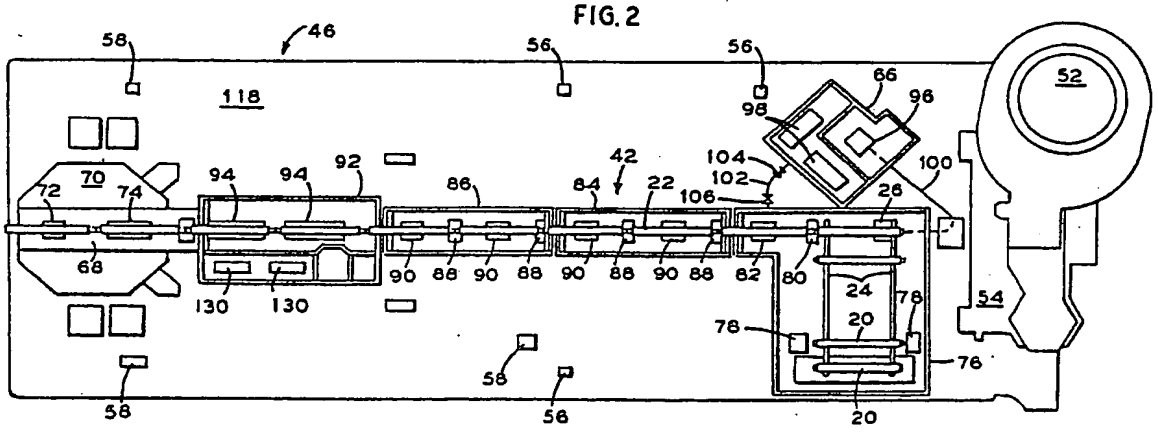
(54) Convertible barge.

(57) A convertible barge having self-contained modules (76, 84, 86, 92) positioned thereon containing pipeline processing equipment has the modules removably attached to the deck (118) of the barge and provided with a closable opening on at least one end thereof for passing a pipeline (22) portion therethrough to another module. Spacer modules may be positioned between the modules housing processing equipment so that modules of standardized dimensions may be used.

FIG. 2



EP 0 271 184 A1

CONVERTIBLE BARGE

The invention relates to the laying of pipeline from a barge.

When oil and gas wells are drilled and exploited at sea, underwater pipelines are generally used for transporting the gas and oil from the offshore wells or production sites to near-shore or on-shore terminals for storage and/or ultimate delivery of the gas or oil to refineries and then to the consumer. Large numbers of pipelines have been laid offshore along the sea bottom by conventional pipe laying barges to connect the production sites with a near-shore or on-shore facilities. Such conventional barges are usually characterised by a single standard barge hull which is generally rectangular in shape with a bow at the front and operates in surface floating condition with a pipe section assembly line normally disposed along the hull's top side and permanently attached thereto for welding the pipe sections one to the other. As the pipe sections are welded one to the other, the resulting pipeline is paid out from the stern of the barge which is not much above the water line and generally over a stinger which extends from the barge stern and supports the portion of the pipeline which initially enters the water. The pipeline processing equipment is normally enclosed by a structure which is again permanently attached to the hull's top side for protecting the equipment from the elements.

Although some smaller diameter pipeline may be wound onto a large spool or wheel and thereafter unreeled and laid at the pipelaying location from a barge, the laying of larger diameter pipeline such as pipeline over 305mm (12 inches) in diameter is usually done by welding segments of 12 to 24 metre (40 to 80 foot) lengths of metal pipe together and passing them over the stern to a stinger assembly as the pipeline is being constructed by the welding of the lengths together.

Beginning at the bow of the vessel, typical permanently attached pipeline processing equipment includes the following:

1. End facing units - The pipe joint ends are bevelled as required by two or more end facing units. These units usually comprise a milling head and support devices to provide the necessary in-and-out travel of the cutting heads. The support apparatus is welded into the barge, but the end facing machines are portable.

2. Pipe joints conveyors - The conveyors are loaded by use of the vessel's cranes with pipe sections. The sections of pipe are then transferred over the conveyor to a line-up station. The conveyor holds several sections of pipe thereby providing a queue of sections to the line-up station. The conveyors are permanently welded to the vessel's work deck.

3. Pipe section line-up station - A line-up unit is used to align a new section of pipe to the pipe that has been welded or partially welded to the pipe string. The line-up units are permanently welded to the vessel's work deck, but line-up clamps are portable. Controls for the line-up units are usually permanently installed.

4. Fixed roller station - Several multiple roller units, over which the pipeline travels during pipelaying operations, are permanently welded to the work deck of the barge.

5. Welding equipment - Usually several welding stations are provided along the line of the pipeline to make several welding passes. These stations comprise welding machines and work platforms. The work platforms are permanently built into the vessel's structure, but the welding machines are usually portable.

6. Radiographic stations - One or more radiographic units are used for non-destructive testing of the pipe joint welds before mastic is applied. The radiographic station includes shielding materials, such as lead sheathing or concrete, and radiographic units. The shielding materials are used to protect the barge personnel from the radiation hazard and are usually a permanent part of the vessel's structure. The radiographic units are normally portable, and are not usually retained on the vessel unless it is actively engaged in pipelaying operations.

7. Pipe tension machines - One or more tension machines are usually permanently installed directly on the work deck of the barge to provide linear hold-back tension on the pipeline. This hold-back tension is needed to prevent excessive bending stresses from occurring in the sag bend. The sag bend is that portion of the pipeline catenary that exists when the pipeline is laid on the ocean floor and the pipeline profile is changed from semi-vertical to horizontal. Controls for the tension machine are normally permanently installed in the barge's permanent structure. Hydraulic power units are permanently welded to the barge deck or installed permanently in the machinery deck of the barge.

8. Field joint station - One or more field joint stations are outfitted with equipment for crushing, melting, and distributing mastic or aggregate mixture on the non-coated sections of pipe, left bare, for the purpose of end to end joint welding. These stations require supports which are permanently welded into the barge structure.

Also near the bow of the vessel, near the pipe joint conveyors, there is provided an abandonment and recovery winch unit for laying down of the pipeline onto the ocean floor or picking up the pipeline after abandonment. The winch is usually diesel powered or hydraulically powered. For hydraulically powered winches, the power units are usually mounted on separate skits. The winch is usually permanently weld-mounted to the deck or below-decks in the machinery spaces. The power units, if required, are usually permanently mounted in the vessel structure.

Thus, a large part of the equipment necessary for pipeline processing and laying on conventional barges is mounted in such a manner as to preclude easy removal and transfer from the vessel. If this equipment could be removed from the barge during times when it is not being used for pipelaying, it would make available a large amount of valuable deck cargo space particularly for combination heavy lift/pipelaying barges. In addition, the permanent installation of such equipment precludes its utilization in a different vessel without costly removal processes.

According to the invention there is provided a pipelaying barge having a deck and
characterised by a plurality of modules position on the deck in end to end relation with at least some of the modules containing pipeline processing equipment, the modules being removably attached to the deck and each module comprising a floor, a ceiling and a pair of side walls extending longitudinally of the barge between the ends of the module; and
means defining a closable opening in at least one end of each of the modules for passing a pipeline portion from the module to a respectively adjacent module as a pipeline is being processed.

Thus modules may be attached to the deck by tack welding and are provided at at least one end with the closable opening for passing a pipeline portion therethrough to another module. Pipeline processing equipment placed in each module is thus easily moved with the module and also protected from the elements.

Pipeline processing and laying equipment aboard a barge can thus easily be removed therefrom and installed on another barge.

Even though portable, the equipment can be protected from the element while in use and during storage.

An easy view of the pipelaying operations may be provided during use.

The invention is diagrammatically illustrated by way of example in the accompanying drawings, in which:-

Figure 1 is a side view of one embodiment of a pipelaying barge according to the invention;

Figure 2 is a plan view of the barge of Figure 1;

Figure 3 is a perspective view of a portion of a module of a pipelaying barge according to the invention with the module in use;

Figure 4 is a view similar to Figure 3 with the module not in use;

Figure 5 is a sectional view illustrating the connection of two adjacent modules during use;

Figure 6 is a schematic plan view of a pipelaying barge according to an alternative embodiment of the invention; and

Figure 7 is a side schematic view of the barge of Figure 6.

Referring firstly to Figures 6 and 7, there is shown schematically a barge generally illustrated at 10 having a pair of sides or hulls 12, a bow portion 14, a stern portion 16, and a main or work deck 18. For the purpose of this specification and the appended claims, a "barge" is any craft which is capable of movement over a body of water either under its own power or by the use of tugs or other means of towing or pushing the craft.

Shown at 20 is a pipe section of perhaps 12m (40 feet) in length whose ends are welded to ends of other pipe sections and otherwise processed in a continuous process, one pipe section after another, thereby to form a pipeline illustrated at 22 which is paid out from the stern of the barge and over a stinger (not shown) which extends from the barge stern as the pipeline is being formed and processed.

As the pipeline is being formed and processed, a pipe section is moved through a series of stations at each of which work is performed thereon. Initially, the pipe section travels along conveyors illustrated at 24 and passes by end facing units (not shown in Figures 6 and 7), then to a line-up station illustrated at 26 so that it may be aligned to the pipe that has already been welded or partially welded to the pipe string. As each pipe section is welded to an adjacent pipe section and is moved toward the stern of the barge to be laid out, it is moved through a series of processing stations housing pipeline processing equipment such as welding equipment, support units, radiographic equipment, pipe tensioning equipment, and equipment for applying mastic or aggregate mixture on the non-coated portions of pipe sections 28 at the joints which are welded, which pipeline processing equipment is schematically illustrated at 30. At 32 is shown a portion of pipeline on which all of the processing steps have been completed and which is being laid out over the stern of the barge, i .e., being laid on the ocean floor. Schematically illustrated at 34 and 36 are an air compressor unit and a generator unit respectively. Illustrated at 38 and 40 are a station for an abandonment and recovery

winch and a power pack station respectively. The power pack station 40 may provide electrical or hydraulic power and may be portable or permanently contained in the barge.

It may be desirable at times to remove the pipeline processing equipment from the barge either to make additional room for valuable cargo space or so that the equipment may be utilized in a different vessel, but it is desirable that costly removal processes and/or costly installation processes should not be involved. In order to provide for easy removal of the pipeline processing equipment and easy installation on another barge, the pipeline processing equipment for each station is contained within a module such as that illustrated at 42. A plurality of such modules are shown in Figures 6 and 7 positioned on the main or work deck in end-to-end relation and removably attached to the deck by means such as tack welding. Each of the modules is preferably of such a size that it can be easily picked up by a crane of the barge or of another barge and removed therefrom after the tack welds are removed and after the modules are detached from adjacent modules as will be hereinafter described.

The modules containing pipe welding stations may be interchangeable with other modules containing pipe welding stations. A typical processing of a pipeline requires several such pipeline welding stations each of which makes one pass. In order to provide greater interchangeability of different size modules on different size barges, spacer modules such as that illustrated at 44 may also be provided. Such spacer modules do not contain any pipeline processing equipment but are provided to fill in the space between adjacent modules that do contain such equipment to prevent any of the pipeline processing equipment from being exposed to the elements during processing.

The pipeline processing equipment may be conventional equipment commonly known to those of ordinary skill in the art to which this invention pertains, and this equipment will therefore not be further described herein.

Referring to Figures 1 and 2, there is shown a typical barge generally illustrated at 46 which may utilize modules illustrated at 42. The barge 46 has a main or work deck 118, a freeboard deck illustrated at 48, and an operating draft shown at 50. The barge may typically have a length of 120-150m (400-500) feet, a width of 49 to 52m (160-170 feet), and a height of 40m (131 feet). The barge contains a heliport shown at 52, at the bow portion 114, a quarters building 54, supply wells 56, hatches 58, a derrick 60 which may be used for lifting the modules as well as other tasks, two smaller cranes illustrated at 62 and 64, and various other equipment typically found on a pipe laying or derrick barge commonly known to those of ordinary skill in the art to which this invention pertains.

On the barge 46 there are provided four modules containing pipeline processing equipment as well as an abandonment and recovery winch module illustrated at 66. Compared to some derrick barges which may have derricks of 1,016 to 5,080 tonnes (1,000 to 5,000 ton) capacities, and although the sizes and weights of the modules may vary, it is expected that typically a crane or derrick such as the derrick 60 would require a minimum of 305 tonnes (300 tons) to lift the modules. The cranes 62 and 64 for lifting pipe and the like may typically have a capacity of 102 tonnes (100 tons). If a derrick does not have sufficient reach to position certain modules at determined positions on the deck or to remove modules from determined positions, it may be necessary to jack modules along the deck so that they are within the derrick's reach or to jack them to their required position from the derrick's reach. Alternatively, another barge carrying a derrick may be brought alongside of the barge to lift the modules.

Although the pipeline processing is shown in Figures 1 and 2 to be centred between the sides of the barge, it is not necessary that it be so centered. Instead, the pipeline may be processed on one side or the other of the barge.

On derrick barges, the derrick is typically centred at the after end portion midway between the sides as shown in Figure 2. In such a case, an opening illustrated at 68 may be provided in a derrick tub 70 below any rotating parts of the derrick for passage of the pipeline as it is being laid, which opening may contain support rollers 72 and 74 and a field joint station for applying mastic or aggregate mixture on the non-coated sections of pipe left bare during welding. The equipment contained within the derrick tub opening may be permanently attached to the vessel.

With the modules in place as shown in Figure 2, pipe sections 20 are lowered through an opening in a first module 76 onto conveyors 24 where they are conveyed by end facing units 78 which bevel the pipe joint ends and then conveyed to the line-up station 26 to the pipe that has been welded or partially welded to the pipe string 22. A welding machine is illustrated at 80 to provide an initial welding pass and a support roller is shown at 82. In the next two modules 84 and 86 are shown welding machines 88 and support rollers 90. In the fourth module 92 are shown a pair of tensioning machines 94 and a control house therefor. In the abandonment and recovery winch module 66 are a winch 96 and a pair of hydraulic power units 98 therefor. Shown schematically at 100 is a line for attaching to the end of a pipeline string for the purpose of lowering it to the ocean floor or for picking it up off

of the ocean floor as the needs may arise. Although the modules are generally self-contained, since the hydraulic power packs for the abandonment and recovery winch are only used occasionally and generally not when it is necessary to use the hydraulic power packs for the first module, means may be provided for supplying hydraulic power from the hydraulic power packs and the abandonment and recovery winch module to the first module as illustrated by a line 102 with valves at 104 and 106 sealing each of the modules at the entrance of line 102. A self-contained hydraulic system may also be permanently contained in the barge in the form of the power pack station 40 as a ready source of hydraulic power. Electricity may of course be supplied to the modules from the barge's power source.

Referring to Figure 3, there is shown a module which includes a floor 108 to which pipeline welding equipment such as a support roller 110 is permanently attached, a ceiling 112, and a pair of side walls 114 and 116 which, as shown in Figures 1 and 2 extend longitudinally of the barge between the ends. The side walls 114 and 116 need not necessarily be totally enclosed, depending on the amount of protection desired. With the exception of the first module, each of the ends has an opening therein illustrated at 120 in Figure 3 for the passage of a pipeline portion illustrated at 22. Although the ends may comprise walls through which a small opening is made for passage of a pipeline portion, in order to permit workers to walk between modules along the pipeline processing stations, and to view the length of the pipeline as it is being processed, it is preferred that the opening extend over substantially the entire width and height of the module as shown in Figure 3.

During pipeline processing and otherwise when the modules are positioned on a barge, it is desirable that the pipeline processing equipment be kept out of the elements and protected from the elements. Referring to Figure 5, wherein a pair of modules such as 84 and 86 are illustrated adjacent to each other in end to end fashion, there are provided brackets 122 and 124 respectively extending along the walls and ceiling of each module at each end having an opening and an elastomeric member 126 extending between and attached to the brackets to seal the space between the adjacent modules from the elements and thus provide means for protecting the pipeline processing equipment from the elements while the modules are in position for use of the equipment. It is of course understood that other suitable means may be provided to achieve this objective.

It is also desirable to protect the pipeline processing equipment as a module is being stored or moved to or from a barge. In order to provide such protection the openings 120 may be provided with roll-up doors 128, illustrated in the open position in Figure 3 and in the closed position in Figure 4, or other suitable means for closing the openings so that the interiors of the modules are sealed from the elements and the pipeline processing equipment is thus protected.

The sealing means between two adjacent modules may comprise a plurality of the elastomeric members 126 in strip form which extend between and along the ceilings and side walls of adjacent modules and which are attached to the ceilings and side walls such as by means of brackets which are attached thereto.

The barge is thus convertible with pipeline processing and laying equipment readily and easily removable therefrom for storage or for positioning on another barge so that the barge may be more efficiently utilized for other purposes. In order to convert a barge to a lay barge, a plurality of modules each of which has a floor 108, a ceiling 112, and a pair of side walls 114 and 116 are positioned on a deck of the barge in end to end relation such that the floor, ceiling, and side walls extend longitudinally of the barge between the ends, pipeline process stations are provided in at least some of the modules, the modules are removably attached to the deck, and a closable opening is provided in at least one of the module ends of each module for passing a pipeline portion from the module to a respectively adjacent module as the pipeline is being processed.

It should be noted that since the abandonment and recovery winch module does not require any openings for passage of a pipeline portion, it is not included in the term "modules" as used in the claims.

The interiors of the modules are sealed from the weather and elements during use by preferably attaching a plurality of elastomeric strips between the walls and ceilings of adjacent modules.

If the openings in the ends were made only large enough for the pipeline to pass through, then of course it would be desirable to provide doors in each of the modules for workers to enter them.

Both welding station modules and support roller modules may be interchangeable.

The fourth module 92 containing the tensioning machines is also provided with one or more self-contained hydraulic power units 130.

The line from the abandonment recovery winch may contain typically a 76mm (three-inch) diameter cable. Beginning with the pipe conveyor and line-up module 132 in Figure 6, the modules progressing toward the stern portion of the vessel may include one of the spacer modules 44, a fixed roller module 134, a weld station module 136, a fixed roller module 134, a weld station module 136, a

fixed roller module 134, a weld station module 136, a fixed roller module 134, a weld station module 136, a fixed roller module 134, a weld station module 136, a fixed roller module 134, an x-ray module 138, a fixed roller module 134, a repair module 140, a fixed roller module 134, a spacer module 44, a tensioner module 142, a spacer module 44, a tensioner module 142, and a field joint module 144 where mastic is applied. Though not illustrated in Figure 2, the field joint module 144 may be positioned in the opening 68 of the derrick tub 70 or aft of the derrick tub 70 forward of the stinger. It should be understood that the above naming of modules by the equipment housed therein is not intended to imply that each module is designed to house only one kind of equipment. The modules are designed to house a variety of equipment, as seen in Figure 2, and are given specific names above only as a matter of convenience in depicting a common arrangement of equipment on pipelay barges.

Claims

1. A pipelaying barge (10, 46) having a deck (18, 118) and characterised by a plurality of modules positioned on the deck (18, 118) in end to end relation with at least some of the modules containing pipeline processing equipment, the modules being removably attached to the deck and each module comprising a floor (108), a ceiling (112), and a pair of side walls (114, 116) extending longitudinally of the barge (10, 46) between the ends; and means defining a closable opening (120) in at least one end of each of the modules for passing a pipeline portion from the module to a respectively adjacent module as a pipeline (22) is being processed.

2. A pipelaying barge according to claim 1, wherein the means defining a closable opening comprises a roll-up door (128) for sealing the module during storage and for providing passageways between the modules and a view of pipelaying operations during use.

3. A pipelaying barge according to claim 1 or claim 2, wherein the modules are attached to the deck (18, 118) by tack welding.

4. A pipelaying barge according to any one of claims 1 to 3, further comprising means for sealing the interiors of the modules from the weather during use.

5. A pipelaying barge according to claim 4, wherein the sealing means comprises a plurality of elastomeric strips (126) which extend between and along the ceilings (112) and sidewalls (114, 116) of adjacent modules and are attached to the ceilings (112) and sidewalls (114, 116).

6. A pipelaying barge according to any one of claims 1 to 5, wherein the modules include at least one spacer module (44) positionable between modules which house pipeline process stations whereby modules of standarized dimensions may be used for housing pipeline process stations.

7. A pipelaying barge according to any one of claims 1 to 8, further comprising means defining hydraulic openings in each of at least two of the modules and valve means (104, 106) to open and close the openings to provide hydraulic service to said at least two of the modules from a single hydraulic power supply means.

8. A pipelaying barge according to claim 7, wherein said at least two of the modules includes a pipe rack conveyor module (76) and an abandonment and recovery winch module (66).

9. A method of converting a barge to a pipelaying barge (10, 46), characterised by the steps of
positioning on a deck (18, 118) of the barge in end to end relation a plurality of modules each of which has a floor (120), a ceiling (112), and a pair of sidewalls (114, 116) extending longitudinally of the barge (10, 46) between the ends;
providing pipeline process stations in at least some of the modules;
attaching the modules to the deck (18, 118); and
providing a closable opening (120) in at least one of the module ends of each module for passing a pipeline portion (22) from the module to a respectively adjacent module as the pipeline (22) is being processed.

10. A method according to claim 10, wherein the step of providing a closable opening (120) includes providing a roll-up door (128) in the module end for providing passageways between the modules and a view of pipelaying operations during use, the step of attaching the modules to the deck includes tack welding the modules to the deck (18, 118) and further comprising sealing the interiors of the modules from the weather, the step of sealing the modules from the weather comprising attaching a plurality of elastomeric strips (126) between and along the ceilings (112) and side walls (114, 116) of adjacent modules.

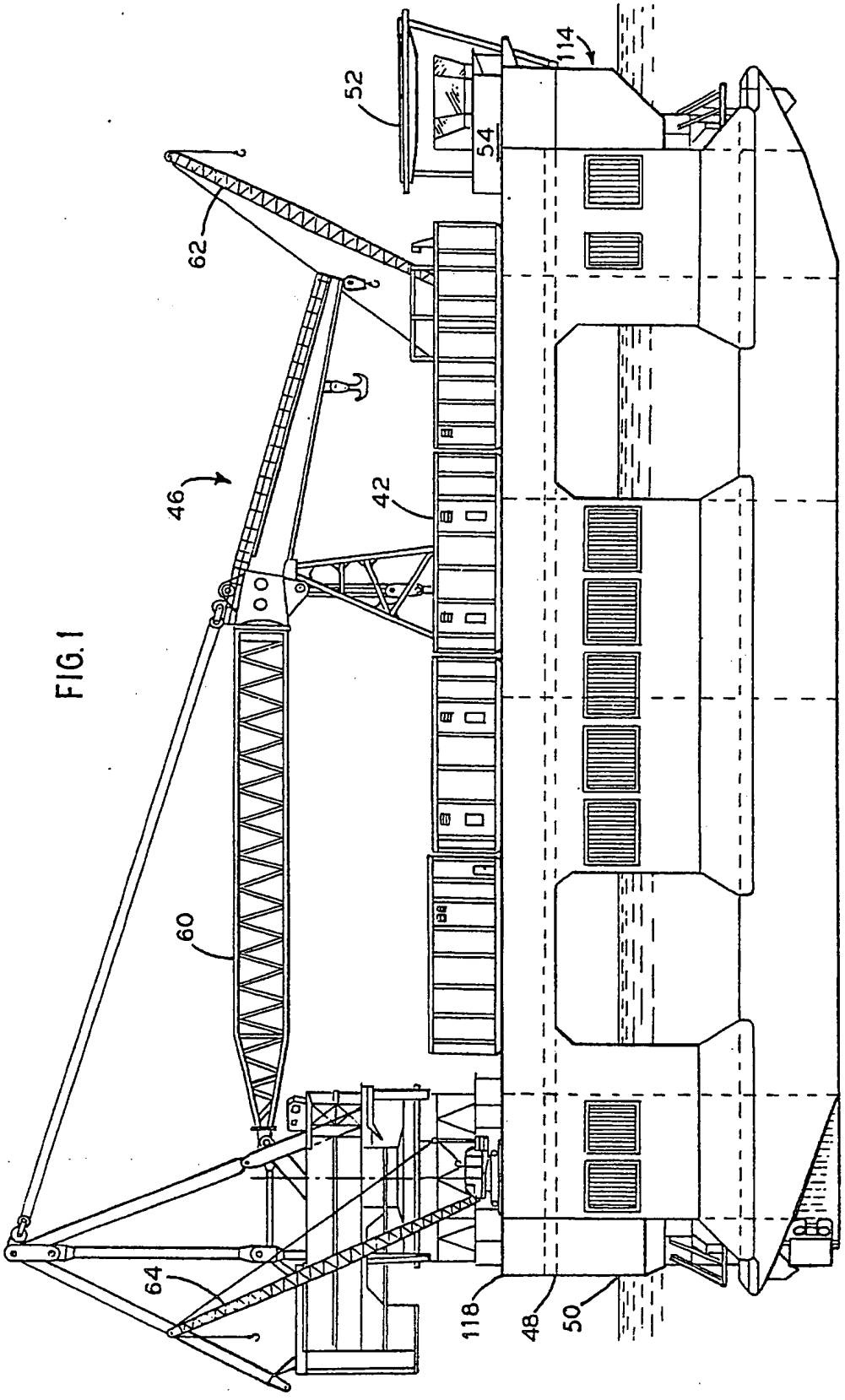


FIG.1

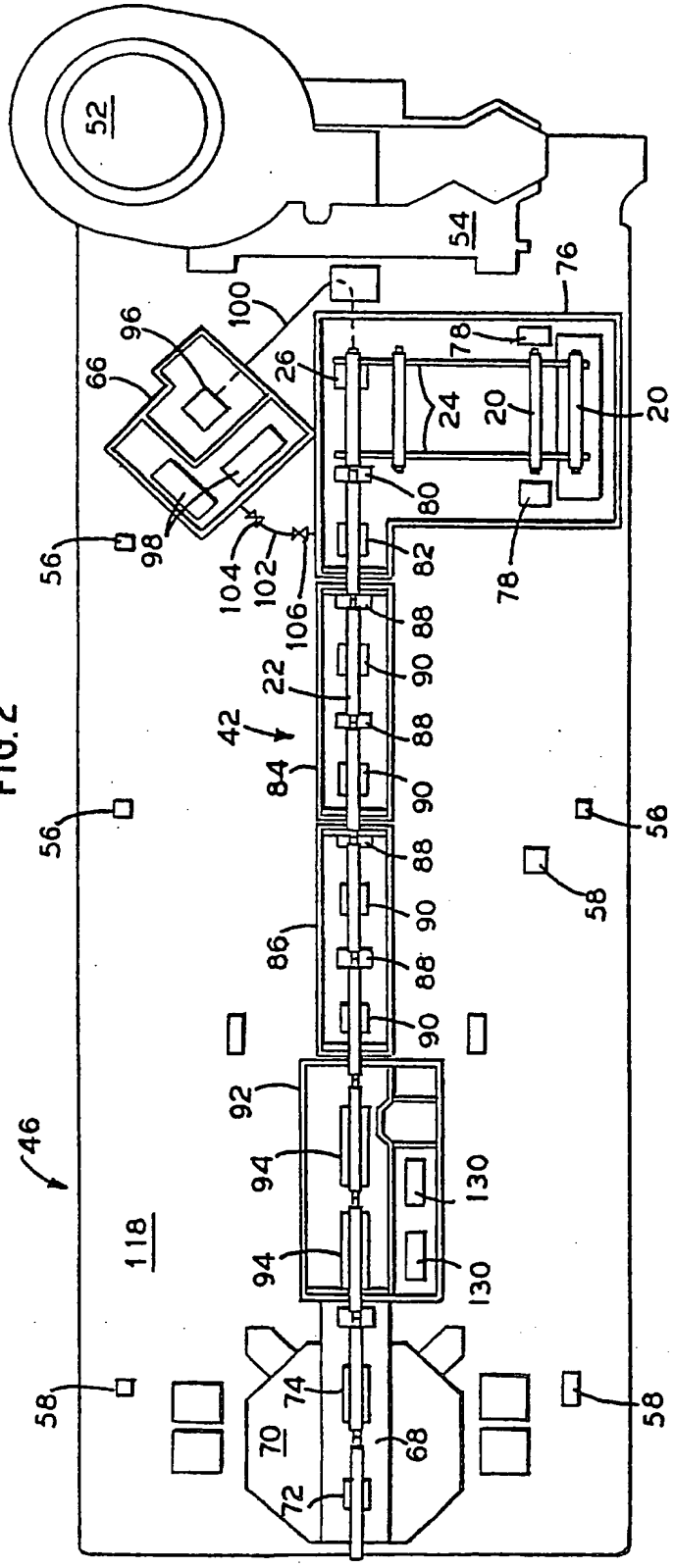

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FIG.2

FIG. 3

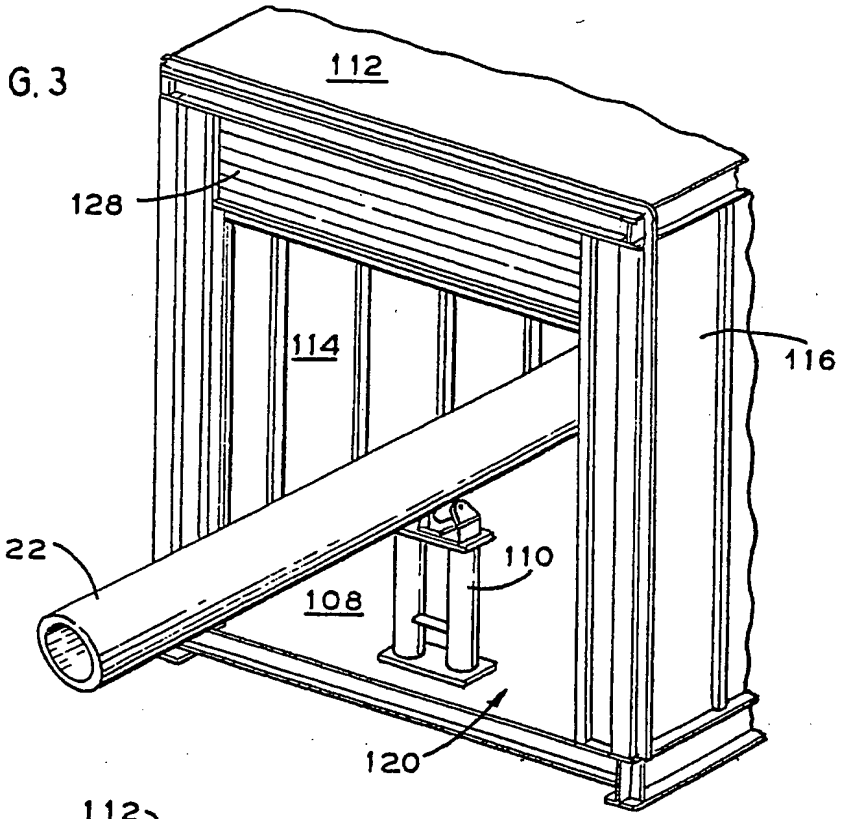

FIG. 4

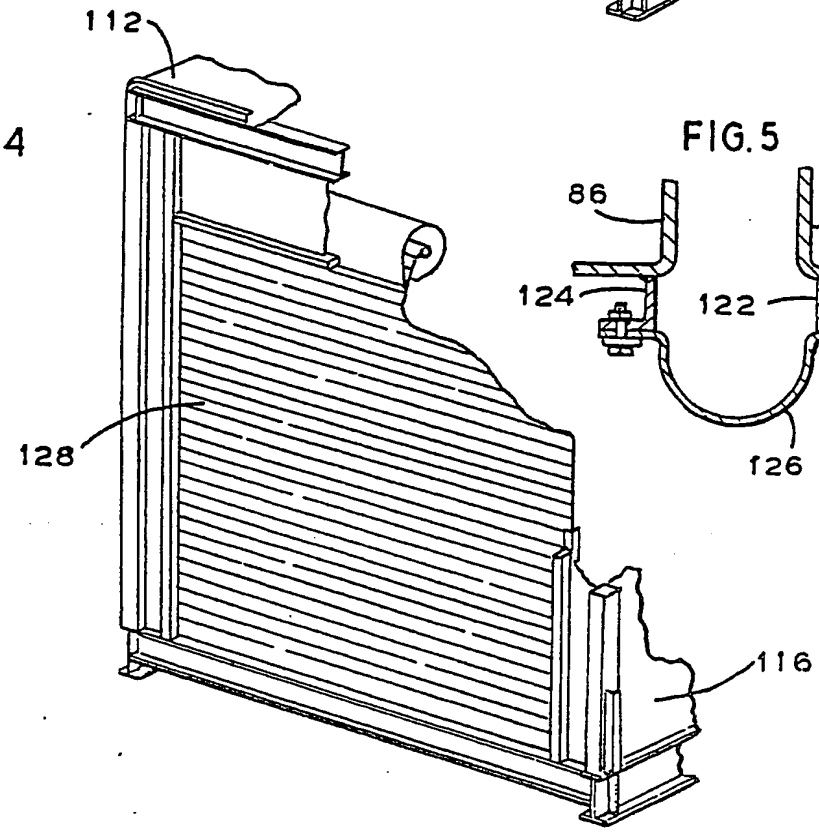

FIG. 5

FIG.6

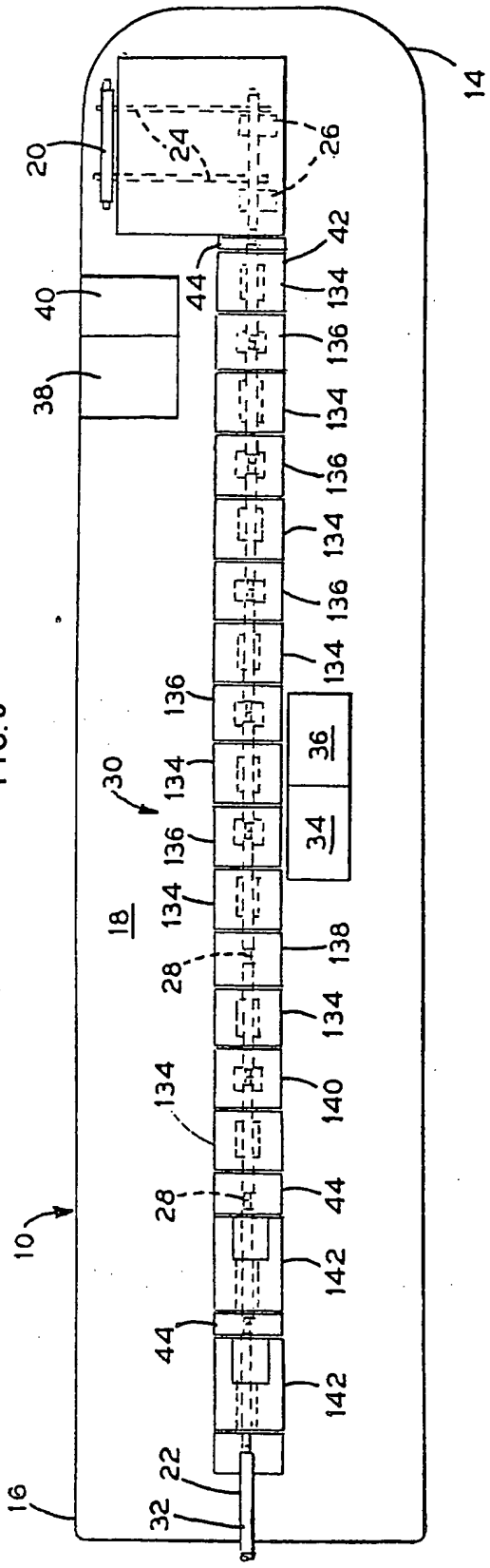
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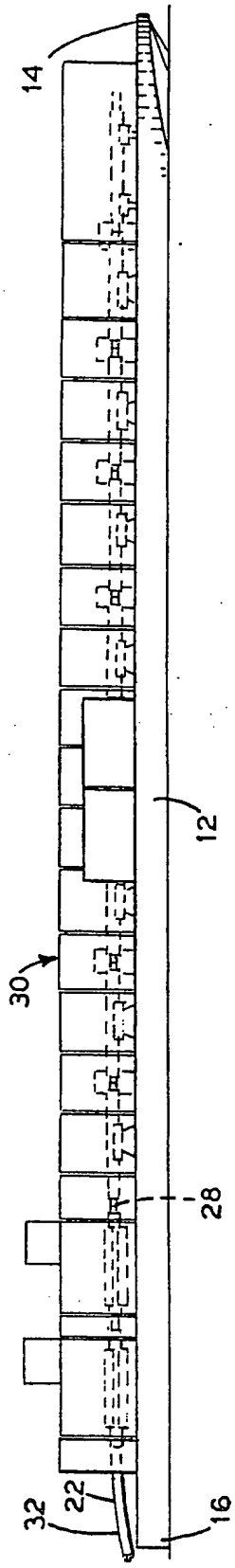
FIG.7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